MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

ECP3126- KNOWLEDGE-BASED SYSTEMS

(BE & RE)

06 MARCH 2018
2.30 PM – 4.30 PM
(2 Hours)

INSTRUCTION TO STUDENTS

1.This question paper consists of 6 pages including cover page with 5 questions only.

2. Attempt **ALL** the **FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

(a) Define knowledge-based systems. Explain the purpose of the three important components of any knowledge-based system. Explain the responsibilities of the three types of personalities involved in any knowledge-based system.

[8 marks]

(b) Draw the life cycle model of expert system development and explain how it is different from the traditional software development life cycle.

[6 marks]

(c) The universe is assumed to be the set of integers, E(x) represents x is even, and O(x), x is odd. Translate the following expression into predicate logic.
"Some integers are even and some are odd".

[2 marks]

(d) Write the steps involved in Hill climbing searching algorithm for an expert system. Name the category of searches it belongs to.

[4 marks]

Question 2

(a) Compare the design of fuzzy expert system and conventional expert system in terms of similarities and differences among them.

[4 marks]

(b) Design a fuzzy controller (specifying the fuzzy input sets, output sets along with their membership functions and rules) for a helicopter auto-pilot. The helicopter must hover at a height of 40m. A throttle position of 50% will keep the helicopter hovering at a fixed position (assuming no wind and other disturbance). A throttle position of 0% will make the helicopter fall at full speed, while a position of 100% will make the helicopter climb at maximum speed. The normal range of height is between 0 and 100m and the rate of change of height is from -20 to +20 m/s.

[10 marks]

(c) "In an anti-lock braking system, the microcontroller has to make decisions based on brake temperature, speed, and other variables in the system. The variable "temperature" in this system can be subdivided into a range of "states": "cold", "cool", "moderate", "warm", "hot", "very hot". The transition from one state to the next is hard to define. An arbitrary static threshold might be set to divide "warm" from "hot". For example, at exactly 90 degrees, warm ends and hot begins. But this would result in a discontinuous change when the input value passed over that threshold. The transition wouldn't be smooth, as would be required in braking situations"
Describe the way to make the transition smooth using fuzzy logic? Show the membership function in drawing.

[6 marks]

Continued...

Question 3

(a) Explain why it is difficult to model a brain-like neural network.

[4 marks]

(b) Identify the Boolean logic gates shown in the form of domain mapping diagram in figure Q3. Which of it cannot be linearly separable? Explain why and suggest a model to separate them.

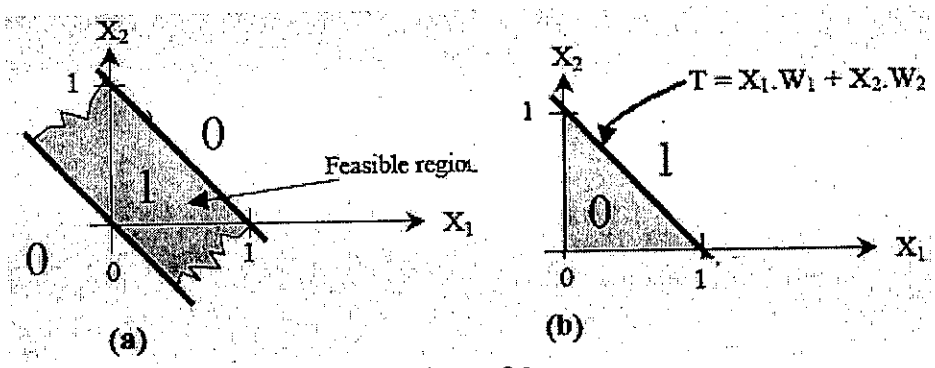


Figure Q3

[5 marks]

(c) Design a McCulloch-Pitts neurons network model that can perform the ANDNOT logic function. Realize your design by using the truth table of ANDNOT logic function.

[8 marks]

(d) What are weights? Identify their role while training an artificial neural network.

[3 marks]

Continued...

Question 4

(a) The network shown in the following figure Q4, when properly trained, should respond with $\begin{bmatrix} Y1 \\ Y2 \end{bmatrix} = \begin{bmatrix} 0.4 \\ 0.8 \end{bmatrix}$

to the augmented input pattern $\begin{bmatrix} X1 \\ X2 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$

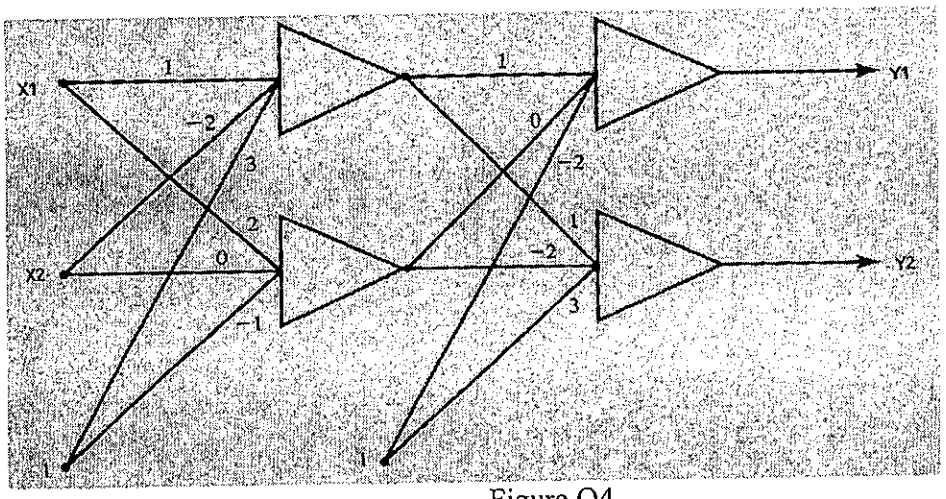


Figure Q4

The network's weights have been initialized as shown in the figure Q4. Analyze a single feed-forward and back-propagation step for the initialized network by doing the following:

(i) Find the weight matrices WH and WO of hidden and output layers respectively.

[2 marks]

(ii) Calculate VH (the total input to hidden layer) and YH (the output of the hidden layer).

[2 marks]

(iii) Calculate VO (the total input to output layer) and Y (the calculated output of the output layer).

[2 marks]

Continued...

(iv) Calculate the error and ∇WO (the small change in the output layer neurons weight).

[4 marks]

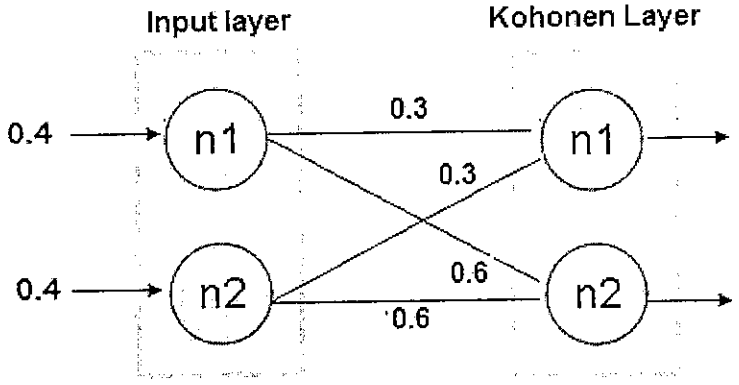
(v) Find the updated weights for only output layer neurons.

[2 marks]

For computations assume Sigmoid activation function $\varphi(v) = \frac{1}{1+e^{-\alpha v}}$

With α equals to 1 and the learning rate η =1.

(b) The following self-organizing Kohonen net shows the input and the weights associated with each connection between the input and the Kohonen layer neurons. Assume the input is normalized and the training parameter α is 0.5.



(i) Which Kohoenen layer neuron will fire? Why?

[3 marks]

(ii) Update the weights as per the output vector. Why should the weights be updated?

[3 marks]

(iii) What kind of algorithm is used in training the Kohoenen layer neurons? Why?

[2 marks]

Continued...

Question 5

(a) Consider the following Bottom_up (B) and Top_down (T) weight matrices of an ART.

$\mathbf{B} =$

0.5	0.5	0
0	0.5	0.5

$\mathbf{T} =$

1	0
1	1
0	1

Assuming a vigilance parameter of 0.7, show that the input vector X = [0 1 1] is recognized by this ART.

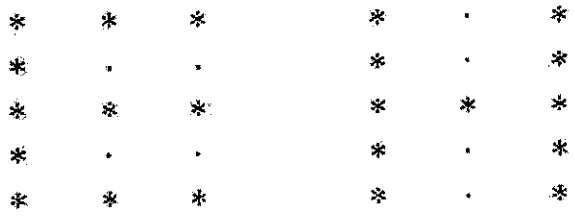
[5 marks]

(b) One of the nice features of human memory is its ability to learn many new things without necessarily forgetting things learned in the past. But most neural networks will tend to forget old information if we attempt to add new information incrementally. Explain how ART overcomes this kind of limitation.

[5 marks]

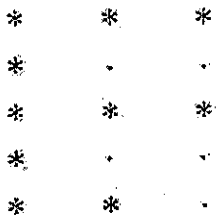
(c) Bi-directional Associative Memory is an artificial neural network for modelling memory. It is designed to store and retrieve information in the form of vectors.

(i) Show how the letter E and H, given by 5 x 3 patterns, are stored in BAM with bipolar target codes (-1 1) and (1, 1) respectively.



[4 marks]

(ii) Test the performance of the BAM when the following noisy version of input pattern **E** is presented.



[4 marks]

(d) Find the difference between the two types of the associative memories.

[2 marks]

End of paper